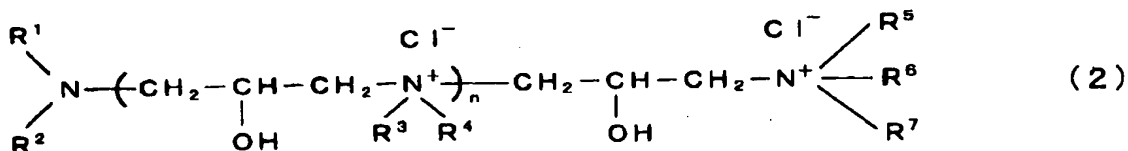


# STATUS OF AMENDMENTS

An Amendment After Final Rejection has not been filed.

## SUMMARY OF CLAIMED SUBJECT MATTER

Appellants' invention, as defined by independent Claim 7, is directed to a copper electrolytic solution for producing an electrolytic copper foil which comprises (A) a quaternary amine salt obtained by a reaction between epichlorohydrin and an amine compound mixture composed of a secondary amine compound and a tertiary amine compound and (B) an organic sulfur compound (paragraph [0019]) of the present specification, and the organic amine salt as expressed by General Formula (2)



where R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup> and R<sup>7</sup> are each a methyl group or an ethyl group and n is a number from 1 to 1,000 (specification page 6, lines 1-4).

## GROUND S OF REJECTION TO BE REVIEWED ON APPEAL

The first ground of rejection to be reviewed on appeal is whether Claims 5-8 are unpatentable under 35 USC 103(a) over Strauss et al in view of Greaves et al. The second ground of rejection to be reviewed on appeal is whether Claim 4 is unpatentable under 35 USC 103(a) over Strauss et al in view of Greaves et al and further in view of Barbieri et al.

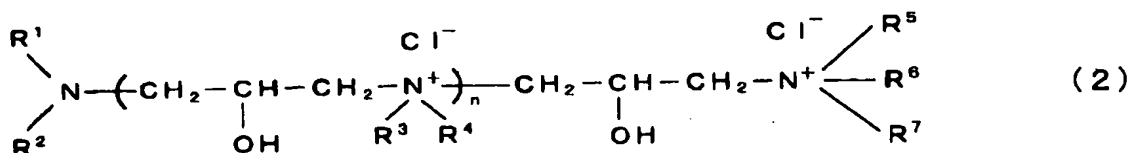
## ARGUMENT

The invention on appeal is directed to a copper electrolytic solution for producing a low-profile electrolytic copper foil with excellent elongation and tensile strength at both ordinary and high temperatures. The copper electrolytic solution, as defined in claim 7, comprises (A) a quaternary

amine salt obtained by a reaction between epichlorohydrin and an amine compound mixture composed of a secondary amine compound and a tertiary amine compound; and

(B) an organic sulfur compound,

wherein the quaternary amine salt is expressed by the following General Formula (2):



and, in General Formula (2),  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$ ,  $\text{R}^4$ ,  $\text{R}^5$ ,  $\text{R}^6$  and  $\text{R}^7$  are each a methyl group or an ethyl group and  $n$  is a number from 1 to 1,000.

Conventional copper foils produced by an electrolytic copper foil producing apparatus have a mirror surface on the side touching the cathode drum but have a rough surface with bumps and pits on the opposite side thereof. With these bumps and pits, undercutting tends to occur during etching and the provision of fine patterns on the foil is very difficult. Given the density provided on printed wiring boards of today, copper foils are needed that can be finely patterned as the circuit width decreases and this requires that the copper foil have a good etching rate and uniform solubility. Additionally, there is a need for the copper foil to have good elongation at ordinary and high temperatures for preventing cracking caused by thermal stresses as well as have a high tensile strength for good dimensional stability in a printed wiring board.

Since the bumps and pits associated with conventional electrolytic copper foils make the copper foils unsuitable for fine patterning, smoothing of the rough side to a low profile has been used to eliminate this problem. However, this makes the process more expensive as it requires the addition of an additive such as glue or thiourea to the electrolytic solution, which sharply decreases the elongation at ordinary

and high temperatures and lowers the performance of the copper foils when used for a printed wiring board. The present invention has been arrived at in order to overcome these problems.

The present invention provides a copper electrolytic solution which can be used to obtain a low-profile electrolytic copper foil having a low surface roughness on the rough side and has reduced transmission loss at a high frequency, can be finely patterned and has excellent elongation and tensile strength at ordinary and high temperatures.

The copper electrolytic solution of the present invention eliminates the necessity of smoothing the rough side of a copper foil to remove pits and bumps associated with conventional copper electrolytic solutions and does not require the addition of an additive such as glue or thiourea. The prior art cited by the Examiner does not disclose the presently claimed invention.

REJECTION OF CLAIMS 5-8 UNDER 35 USC 103(a)  
OVER STRAUSS ET AL IN VIEW OF GREAVES ET AL

The Strauss et al reference discloses a process for producing bright metal electrodeposits in electroplating solutions containing additives which eliminate the adverse effects of impurities and the solutions upon the deposits produced therefrom. That is, this reference discloses a method of electroplating objects in electroplating baths containing brightening agents which makes it possible to produce bright electrodeposits despite the presence of interfering impurities in the electroplating bath. In Strauss et al, N-substituted monoamino compounds, free from carboxyl groups and selected from the group consisting of the compounds having the formula shown in Claim 1 of this reference are added to an acidic copper electroplating bath comprising hard water, technical grade copper salts and a sulfonic acid brightening agent.

Since R, R<sub>1</sub> and R<sub>2</sub> bonded to N in the formula of claim 1 of Strauss et al are not hydrogen, the N-substituted monoamino compounds are apparently tertiary amino compounds as set forth in column 1, line 56 and column 3, line 14 of this reference.

Strauss et al discloses that the addition of the N-substituted monoamino compounds or the tertiary amino compounds prevents the impurities, e.g., magnesium and calcium ions from the hard water, ferric ions from technical grade copper salts, from interfering with the brightening action of the brightening agent and prevent the electrodeposits from being adversely affected by the impurities. The N-substituted monoamino compounds (tertiary amino compounds) in this reference may be in the form of their salts of inorganic compounds and organic acids or in the form of the corresponding quaternary ammonium compounds (col. 3, lines 14-17; and claim 1). Column 4, lines 53-60 cited by the Examiner discloses a quaternary amine compound prepared by mixing together morpholine with epichlorohydrin and this quaternary amine compound includes a heterocyclic morpholino radical including nitrogen.

In contrast to Strauss et al, the quaternary amine salt used in the present invention has to be the reaction product between epichlorohydrin and an amine compound mixture composed of a secondary amine compound and a tertiary amine compound and not a monoamino compound. Although the Strauss et al reference does use an N-substituted monoamino compound (tertiary amine compound), which may be in the form of its salt or quaternary ammonium compound formed with epichlorohydrin, it expressly excludes the use of the tertiary amine compound in combination with a secondary amine compound in a reaction with epichlorohydrin. Even in Example IV of the Strauss et al reference relied on by the Examiner, morpholine is used alone and not in combination with another amino compound. As such, the quaternary amine salt of the presently claimed invention, which is formed by the reaction of a mixture of a secondary amine compound and a tertiary amine

compound with epichlorohydrin, is expressly different from that shown in the Strauss et al reference and the presently claimed copper electrolytic solution is clearly distinguishable from the electroplating bath disclosed in the Strauss et al reference.

In the Examiner's "Response to Arguments", it is still asserted that Example IV of Strauss et al discloses reacting a secondary amine with epichlorohydrin and tertiary amine. Appellants respectfully disagree. In this example, epichlorohydrin is reacted with morpholine but any further amine is not shown. No other amine is used other than morpholine in Example IV of Strauss et al. Further, as mentioned above, Strauss et al expressly require the addition of N-substituted monoamino compounds, i.e., tertiary amino compounds as shown in col. 2 or their salts and quaternary ammonium compounds formed with epichlorohydrin (claim 1, column 3, lines 14-17), which excludes the use of a mixture of secondary and tertiary amines. Although morpholine is a secondary amino compound when hydrogen is bonded to the nitrogen atom, the "morpholine" used and formed into a quaternary compound by reaction with epichlorohydrin in Example IV of this reference is considered to be N-2-chloroethyl-morpholine shown in col. 2 or the like tertiary amino compound in which hydrogen bonded to N is substituted with 2-chloroethyl or another radical, because this reference expressly requires the addition of tertiary amino compounds in col. 1, line 56 and col. 3, line 14 and show tertiary compounds in column 2 as examples of such tertiary amino compounds.

The quaternary amine salt of the claimed invention has been limited to that defined by the general formula (2) of claim 7 and  $R^1$  to  $R^7$  of the quaternary amine are each methyl or ethyl. As such, a heterocyclic radical such as a morpholino group shown in Example IV of the Strauss et al reference is excluded. Further, all of the tertiary amino compounds listed in columns 2 and 3 of the Strauss et al reference are excluded

from the quaternary amine salts of formula (2) required by the present invention. In this regard, the Examiner replied that "the examiner does not find this argument persuasive because Strauss also discloses linear amines" (b. of Examiner's "Response to Arguments"). Among the amines shown in Strauss et al, some amines are linear but they are different from the claimed quaternary amines having  $R^1$  to  $R^7$  as defined in claim 7 and secondary and tertiary amine components. "Linear amines" are not the claimed quaternary amines. The Examiner has admitted that the quaternary amine salt of formula (2) is not explicitly disclosed in the Strauss et al reference and thus the Greaves et al reference is cited as making it obvious to add an additive such as a quaternary ammonium polymer derived from epichlorohydrin and various amines such as secondary and tertiary amines to the electrolytic solution of Strauss et al.

The Greaves et al reference discloses a method for inhibiting corrosion in an aqueous solution which comprises a step of adding to the system a corrosion-inhibiting salt capable of forming a passivating film at the anode and a substantially linear cationic polymer. This reference has been cited by the Examiner as making it obvious to add an additive such as a quaternary ammonium polymer derived from epichlorohydrin and various amines such as secondary and tertiary amines to the electrolytic solution of Strauss et al in order to inhibit corrosion in an aqueous system. Appellants respectfully disagree.

The quaternary ammonium polymer having a formula in column 5 of Greaves et al is completely different from the quaternary amine salt of the present invention. That is, in the compound of the Greaves et al reference, three ethoxy groups are attached to the nitrogen on the left side and a hydrogen and methyl group are attached to nitrogen on the right side. Since the currently presented claims limit  $R^1$  to  $R^7$  to being either a methyl or ethyl group, the quaternary ammonium polymer of Greaves et al is expressly excluded from the presently claimed invention. Therefore, the Greaves et al

reference does not cure the deficiencies of Strauss et al and the combination of these references do not even present a showing of prima facie obviousness under 35 USC 103(a).

As mentioned above, Strauss et al requires the addition of N-substituted monoamino compound and excludes any quaternary compound obtained by the reaction of epichlorohydrin with a mixture of secondary and tertiary amines. Further, the N-substituted monoamino compound or its quaternary compound of Strauss et al is used for producing bright metal electrodeposits but not for inhibiting corrosion. Therefore, the corrosion-inhibiting effect due to the use of the polymer containing quaternary ammonium groups in an aqueous system disclosed in Greaves et al would not have motivated one to use the polymer of Greaves et al instead of the N-substituted monoamino compound in the electroplating solution of Strauss et al with an expectation of the effects derived from the claimed invention. As such, Appellants' respectfully submit that Claims 5-8 are clearly patentably distinguishable over Strauss et al combined with Greaves et al.

REJECTION OF CLAIM 4 UNDER 35 USC 103(a)  
OVER STRAUSS ET AL AND GREAVES ET AL  
AND FURTHER IN VIEW OF BARBIERI ET AL

The arguments advanced above for the combination of Strauss et al and Greaves et al are also used here for this rejection. As for the Barbieri et al reference, this reference discloses an electrolyte composition and process for electrodepositing bright, level and ductile copper deposits on a substrate. The electrolyte contains an additive system comprising a bath-soluble polyether compound, a bath-soluble organic divalent sulfur compound, a bath-soluble adduct of a tertiary alkyl amine with epichlorohydrin and a bath-soluble reaction product of polyethylene-imine and an alkylating agent.

Barbieri et al has been cited by the Examiner as making it obvious to use an organic sulfur compound in the electrolytic solution of Strauss. However, the Barbieri et al reference does not cure the defects contained in the primary Strauss et al reference with respect to the presently claimed invention. Although the Barbieri et al reference discloses as component (c) a bath-soluble adduct of a tertiary alkyl amine with polyepichlorohydrin, this soluble adduct is different from that of the present invention. The quaternary amine salt of the present invention is prepared from epichlorohydrin and not polyepichlorohydrin which is required in Barbieri et al and the present invention requires an amine compound mixture made up of a secondary amine compound and a tertiary amine compound and not just a tertiary alkyl amine which is required in Barbieri et al. The structural difference between the quaternary amine salt of the present invention and the adduct of Barbieri et al is clear from reviewing the formula (2) of the present claims with the formula of the adduct of Barbieri et al.

The Strauss et al and Barbieri et al references disclose an acid copper electroplating bath and Grieves et al discloses a method for inhibiting corrosion in an aqueous system. None of these references discuss a copper electrolytic solution for producing electrolytic copper foils and there is no suggestion or motivation to one of ordinary skill in the art to modify the quaternary amine compounds disclosed there to arrive at the presently claimed quaternary amine salt for modifying an electroplating bath or corrosion-inhibiting agent disclosed therein to an electrolytic solution disclosed in the references to the present invention directed to an electrolytic solution for the production of copper foils. As such, it is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over the prior art cited by the Examiner.



CONCLUSION

For the reasons advanced above, it is respectfully submitted that the presently claimed invention is patentable over the prior art cited by the Examiner. Reversal of the Examiner is respectfully solicited.

Respectfully submitted,

  
Terryence F. Chapman

TFC/smd

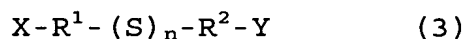
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Encl: Claims Appendix  
Evidence Appendix  
Related Proceedings Appendix  
Postal Card

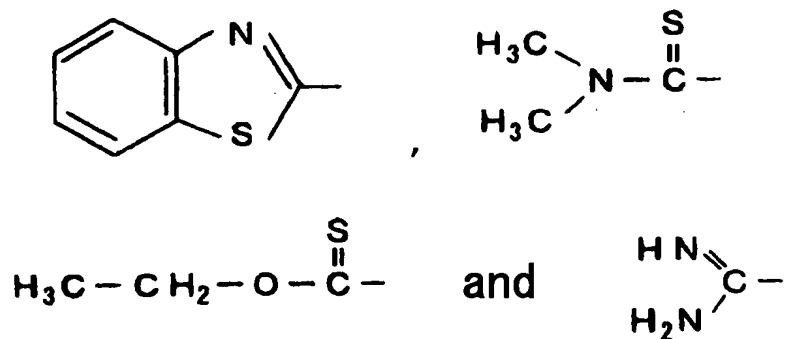
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CLAIMS APPENDIX

4. The copper electrolytic solution according to Claim 7, wherein the organic sulfur compound is expressed by the following General Formula (3) or (4):



, in General Formulas (3) and (4),  $R^1$ ,  $R^2$ , and  $R^3$  are each an alkylene group with 1 to 8 carbon atoms,  $R^4$  is selected from the group consisting of hydrogen,



X is selected from the group consisting of hydrogen, a sulfonic acid group, a phosphonic acid group, and an alkali metal salt or ammonium base of sulfonic acid or phosphonic acid, Y is selected from the group consisting of a sulfonic acid group, a phosphonic acid group, and an alkali metal salt of sulfonic acid or phosphonic acid, Z is hydrogen or an alkali metal, and n is 2 or 3.

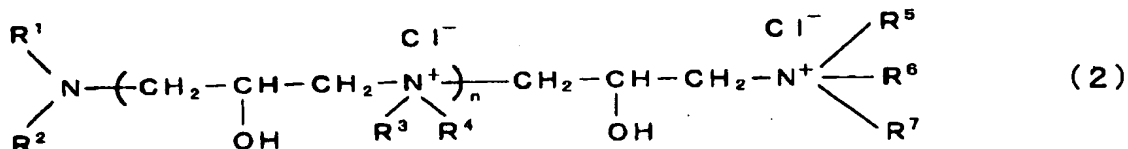
5. An electrolytic copper foil produced using the copper electrolytic solution according to Claim 7.

6. A copper-clad laminated board produced using the electrolytic copper foil according to Claim 5.

7. A copper electrolytic solution for producing an electrolytic copper foil, said solution comprising:

(A) a quaternary amine salt obtained by a reaction between epichlorohydrin and an amine compound mixture composed of a secondary amine compound and a tertiary amine compound; and

(B) an organic sulfur compound,  
wherein the quaternary amine salt is expressed by the following General Formula (2):



and, in General Formula (2),  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$ ,  $\text{R}^4$ ,  $\text{R}^5$ ,  $\text{R}^6$  and  $\text{R}^7$  are each a methyl group or an ethyl group and  $n$  is a number from 1 to 1000.

8. The electrolytic copper foil according to Claim 5, wherein the electrolytic copper foil has a surface roughness  $R_z$  of 0.93 to 1.78  $\mu\text{m}$ , an ordinary-temperature elongation of 3.10 to 10.34%, an ordinary-temperature tensile strength of 31.0 to 76.5  $\text{kgf/mm}^2$ , a high-temperature elongation of 8.8 to 18.5%, and a high-temperature tensile strength of 20.0 to 23.0  $\text{kgf/mm}^2$ .

EVIDENCE APPENDIX

There is no evidence being relied on by Applicants in the appeal.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings to the present application.